The NEW HOT and COLD STRIP MILLS

By JOSEPH L. BITONTI, '38

"WATCH steel! How often have you heard economists and investment experts utter these words? For years, it has been a custom to use the activity of the steel industries as a barometer in forecasting the business and industrial activity of the nation.

So, when an industry producing capital goods begins to expand widely and replace obsolete equipment in great haste, then one can look into the near future optimistically. Every one is aware of the fact that the steel companies are expanding as the newspapers have been filled with these pleasant news stories. This expansion is in the direction of improving methods of producing sheets and plates to meet the specifications of the automobile industry and other fabricators, which ultimately will lead to the fabrication of steel houses.

The improvement in sheet production is brought about by the continuous hot mills and the continuous cold reduction mills, commonly called "hot strip" and "cold strip" mills. The new strip mill is not only the latest and largest improvement in steel manufacturing history, but also the biggest and most modern improvement in all industry.

Size

The new "hot strip" mill of the Youngstown Sheet and Tube Company, Youngstown, Ohio, is in operation at its Campbell plant and is enormous in size. Some idea of the size of the mill may be had from the fact that 400 freight cars were required to carry the strip mill equipment which weighed 14,000 tons! The foundation of the mill required 35,000 cubic yards of concrete which covered an area of about seven acres with an over-all length of about one-quarter of a mile.

The raw material or the hot strip mill is the "slab" (approximately ½ x 4 x 8 ft. in size) which is converted into a hot rolled steel sheet of specific size, thickness, and finish, depending upon the specifications of the purchaser.

The first step in the process is the heating of the slab to the required temperature. This is done in three furnaces, each 82 feet in length, having a total capacity of 150 tons per hour. As each cold slab is admitted into the furnace, a white hot slab is automatically pushed out into the line of rollers. At this point, the slab begins its journey through the continuous hot mill.

"Roughing It"

The next step consists of a "scale breaker" which is the first stand of rolls; they are designed to remove the scale from the heated slab. On the other side of the scale breaker, the slab is washed by water under a pressure of 1000 pounds per square inch.

From the scale breaking rolls, the slab is turned at an angle of 90 degrees and is now carried towards the other rolls lengthwise. It is then "cross rolled" for the desired width after which the slab is turned another 90 degrees and is restored to its original position.

Now comes the successive rolling processes which are designed to accomplish further reductions in the thickness of the steel, with proportional increase in its length, at the same time governing the width to conform with the specifications. The slab passes through three "roughing mills" in succession known as the "four-high type" mills. That is, each consists of four horizontal rolls with the steel passing through the smaller pair of rolls in the center. The smaller rolls are friction driven by the much larger top and bottom rolls which furnish the pressure required to reduce the thickness of the steel. The size of these roughing mills is tremendous. They are 22 feet high, the top and bottom rolls weigh 100,000 pounds each with the center rolls weighing 22,000 pounds each.

At this time, the hot steel again becomes oxidized, so it is necessary to pass it through another scale breaker and the hydraulic spray. The slab is now greatly elongated and is ready for the finishing process by going into the six "finishing mills."

"Finishing It"

The "continuous" feature of these mills comes into evidence at the six "finishing stands." Each one of these finishing stands (they are similar to the roughing stands as they have four horizontal rolls, two large ones and two small center rolls) performs successive reduction in the thickness of the steel; of course, the elongation increases. The last stand brings the steel down to the required gage thickness which may be from one-half inch to 18 gage thick. Now, the steel is so greatly elongated, that when one end is "finished," the other end may not have passed the first finishing stand. For this reason, the six finishing stands must be coordinated. Each successive stand must operate a little faster than the preceding one; the greater the reduction in thickness, the operating speed of the successive stands must also be greater.

The six finishing stands are so large that their combined weights are 5,000,000 pounds, and if the rolls were removed, a standard automobile could drive down through the center! In spite of this enormous size, this mechanism is as perfectly timed as a watch! It is electrically controlled from a central point in the mill.

The steel comes from the last finishing stand in the form of a long strip reduced to the desired thickness, the length varying inversely with the thickness. "Hot-flying shears," synchronized with the last finishing stand, cut the material to the specification length, or it may be rolled

into a coil and sent to the "cold strip mill." With this arrangement, it is possible to handle very heavy slabs, some being as heavy as 12,000 pounds.

Auxiliary Equipment

Beyond the hot-flying shears, for a length of 700 feet, lies auxiliary or "run-out equipment" which includes "tables," "hot levellers," "transfers," "coilers," and "cold-flying shears." The hot mill processing lines for final finishing of the sheets consists of "rotary shears," "levellers," "up-cut shears," "pilers," "normalizing furnace," "pickler," "scrubber," "dryer," and "oiler."

The entire hot mill process may be summarized by saying that the six roughing mills and the six finishing mills reduce the steel from a slab to a long steel sheet of desired width and thickness. But, the process beyond that point serves to complete and perfect the product for the market.

In the continuous hot mill, there is an accurate control of rolling and cleansing processes which insures a good finish, accurate gage thickness, width, and length.

Visitors to the plant are always amazed by its size. After viewing the process from slab to the long strip of sheet, the auxiliary equipment holds their interest. The enormous overhead electric cranes, the 30,000 gallon water tank to cool the rolls (the rolls require 20,000,000 gallons of water a day), the many panels of electric switchboards, the motor room consisting of motor generators and motors which can supply 45,000 hp., and the mass of electrical equipment used to synchronize motor generators to motors as well as the speeds of the successive rolls.

The "Cold Strip" Mill

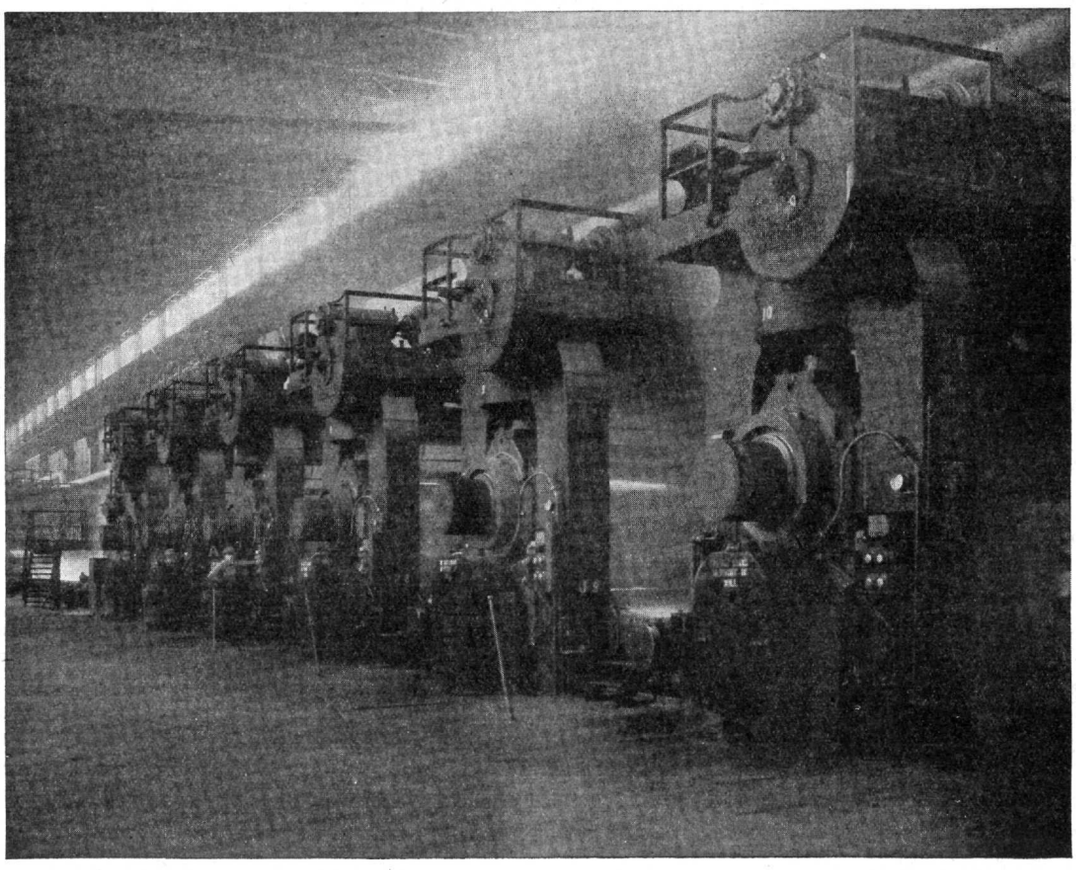
The continuous cold strip mill is adjacent to the hot strip mill. It is much smaller than the hot strip mill as it has only a three-stand, four-high tandem cold reduction mill and will roll material up to 72 inches wide with a capacity of 150 tons to 250 tons per eight-hour shift.

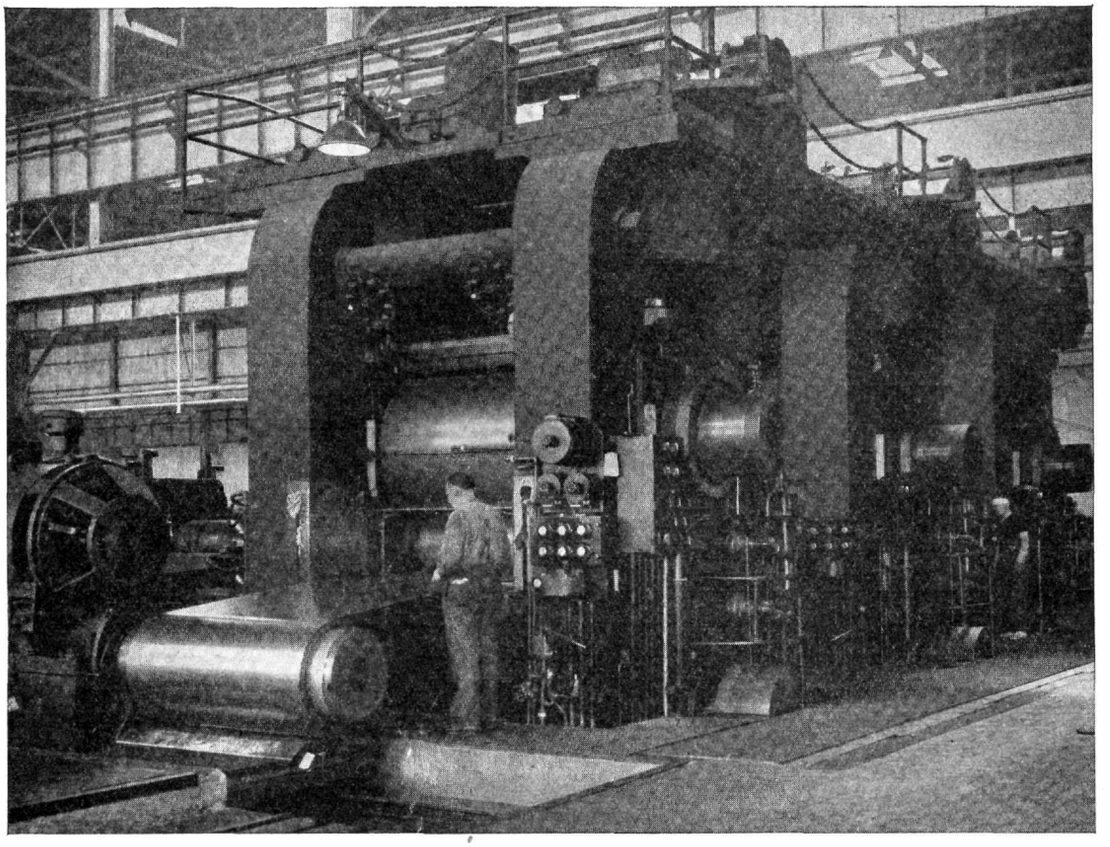
A continuous pickling unit leads from the hot strip mill to the cold strip mill. The coiled material is unwound, the ends are sheared; it is then passed through a flattener, and the end of one roll is stitched to the end of the preceding roll. Continuous pickling is obtained with this equipment at the rate of 80 feet per minute.

The most interesting feature of the mill is that the original slab may be reduced to a strip one-eighth inch thick and 500 feet long by the hot strip mill. The cold strip mill may reduce it from this point to a thickness of 0.05 inches and 1,250 feet long. These long strips are rolled up into coils to facilitate handling and shipping. This great reduction is brought about by thirteen continuous sets of rolls, ten rolls in the hot strip mill and three rolls in the cold strip mill.

SIX HOT STRIP FINISHING STANDS

Courtesy Youngstown Sheet and Tube Co.





Courtesy Youngstown Sheet and Tube Co.

COLD REDUCTION MILL IN OPERATION

Due to the demands of the automobile industry, this firm is pioneering in the rolling of sheets up to a width of 90 inches. This is accomplished by a single stand mill, 93 inches wide, and by cross rolling the sheets. That is, a piece 90 inches long is sheared from the sheet passing the cold mill and is then passed through the 93-inch rolls with the 90-inch dimension becoming the width of the new sheet. It is then rolled to the desired length, the width remaining 90 inches.

The construction of the continuous hot mill began in July, 1934, and was in operation in March, 1935. The continuous cold mill was completed a short time after March, 1935. The combined floor area of these two mills is slightly more than twelve acres!